Requested Patent: GB2004807A

Title:

IMPROVEMENTS IN MIXING FIBRE- REINFORCED CEMENTITIOUS MATERIAL ;

Abstracted Patent: GB2004807 ;

Publication Date: 1979-04-11 ;

Inventor(s): ;

Applicant(s): GILLESPIE D L ;

Application Number: GB19780038067 19780925 ;

Priority Number(s): GB19780038067 19780925; GB19770040046 19770926 ;

IPC Classification: B28C5/40 ;

Equivalents: ;

ABSTRACT:

Cementitious material e.g. plaster and a fibre reinforcement are mixed before water is added e.g. by a spray head 38 to hydrate the mixture, which is then dried e.g. by a hot air oven 34. The mixture can be vibrated 36 before, during and after the water is added. The plaster 23 and fibre reinforcement is supplied continuously to a conveyor belt 13 and is mixed by combs 24/25 and smoothed by a doctor blade 26. Chopped glass fibres rovings or tissue 16 are used.

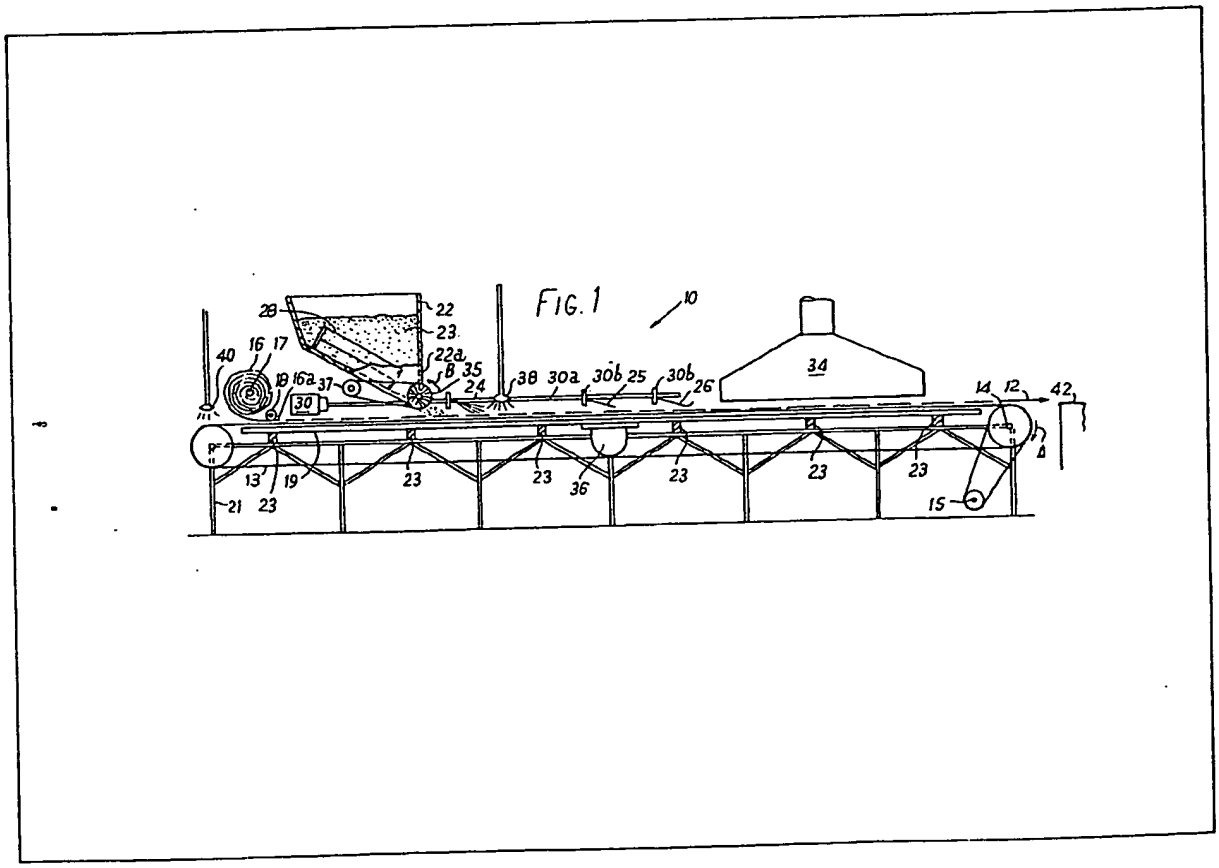
(12) UK Patent Application (19) GB (11) 2 004 807 A

(21) Application No. 7838067
(22) Date of filing 25 Sep 1978
(23) Claims filed 25 Sep 1978
(30) Priority data
(31) 4004677
(32) 26 Sep 1977
(33) United Kingdom (GB)
(43) Application published 11 Apr 1979
(51) INT CL²
B28C 5/40
(52) Domestic classification
B5A 1R150 1R214D 1R214E 1R214F 1R455 20T4 2A4B 2D1X 2Q2X D32
(56) Documents cited
GB 1448265
GB 1417001
GB 1346767
GB 1258288
GB 753064
GB 528657
(58) Field of search
B5A

(71) Applicant
David Langford Gillespie,
Grovers Farm,
Dippenhall, Farnham,
Surrey
(72) Inventor
David Langford Gillespie
(74) Agents
Gee & Co

(54) **Improvements in mixing fibre-reinforced cementitious material**

(57) Cementitious material e.g. plaster and a fibre reinforcement are mixed before water is added e.g. by a spray head 38 to hydrate the mixture, which is then dried e.g. by a hot air oven 34. The mixture can be vibrated 36 before, during and after the water is added. The plaster 23 and fibre reinforcement is supplied continously to a conveyor belt 13 and is mixed by combs 24/25 and smoothed by a doctor blade 26. Chopped glass fibres rovings or tissue 16 are used.



GB 2 004 807 A

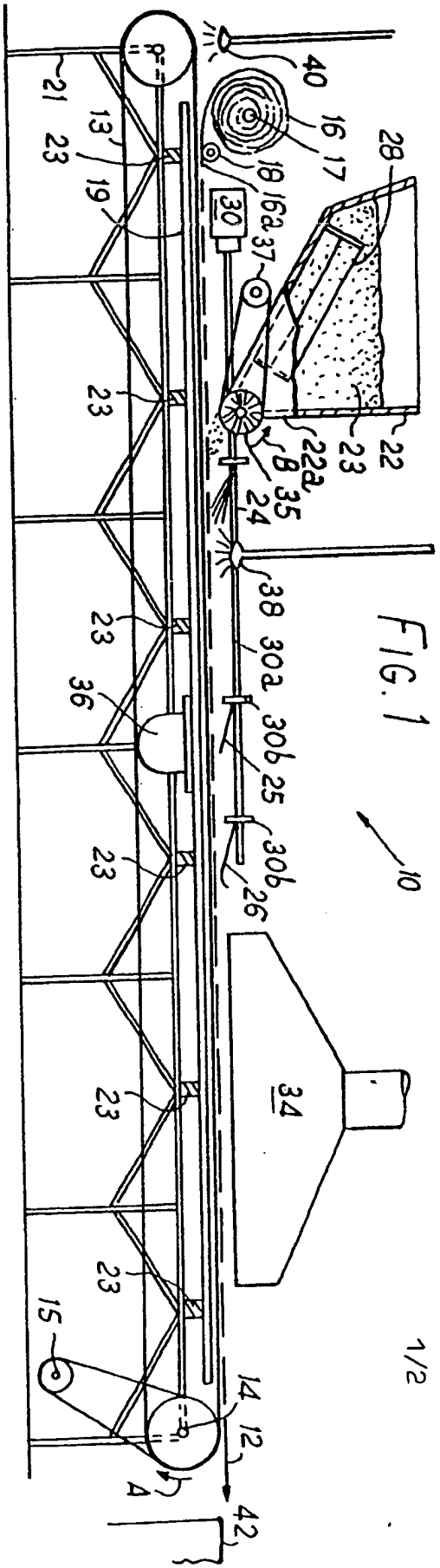

40
16
17
18
16a
37
30
28
21
13
23
19
22
22a
35
24
38
30a
30b
25
26
36
34
15
14
12
42
A
10

FIG. 1

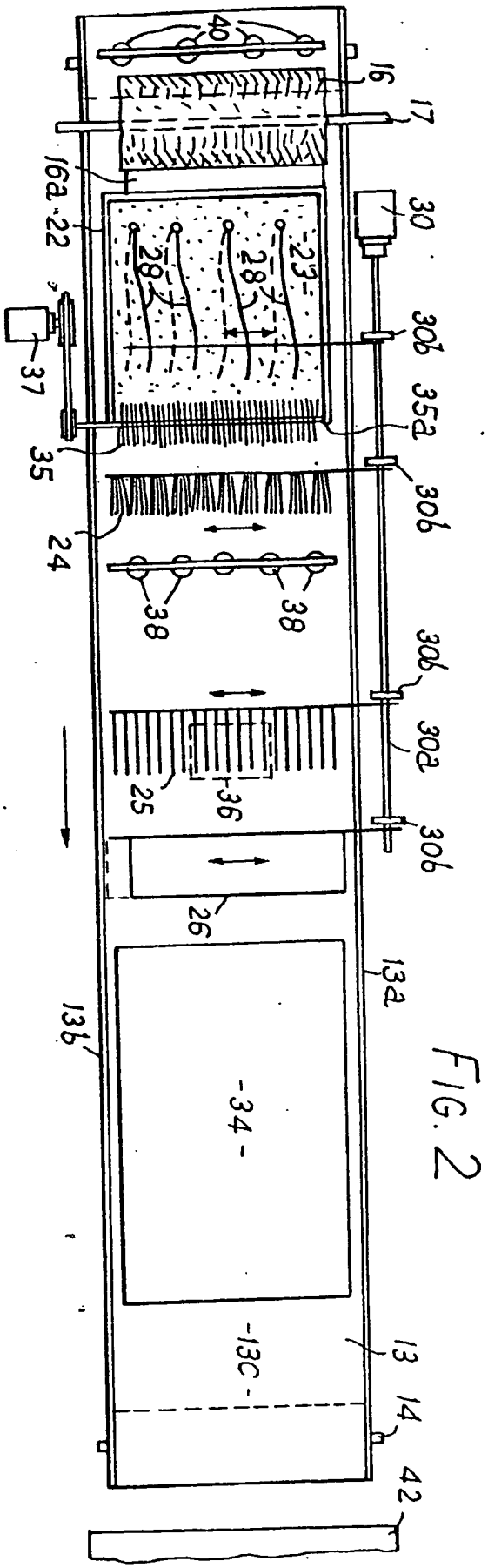

40
16
17
16a
22
23
28
30
30b
35a
37
35
24
38
25
36
26
13a
13b
34
13c
13
14
42

FIG. 2

1/2

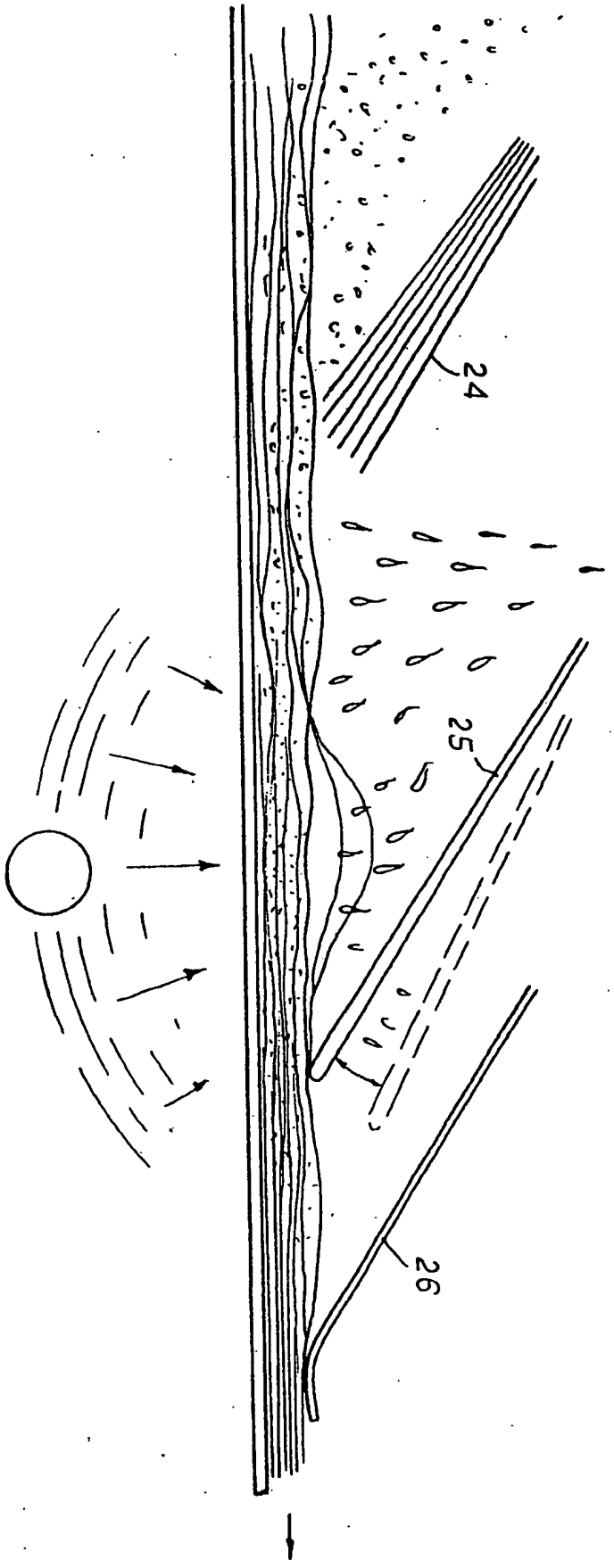


FIG. 3

SPECIFICATION

Improvements in or relating to fibre-reinforced plaster products

This invention relates to fibre-reinforced plaster products, such as laminae and methods for their production.

Laminae of a resin, usually polyester, reinforced with glass fibre find many applications in architecture, for example in partitions and in ceilings having a complex structure to conceal lighting and other services. Such laminae are inherently combustible and the additives that are used in order to render them fire-resistant or fire-retardant often give rise to very toxic fumes in the event of a fire; moreover, despite the properties imparted by the additives, the resin in the laminates still tends to emit a great deal of smoke when subjected to high temperatures.

Glass-fibre reinforced gypsum plasterboards, mouldings and extrusions have been proposed for constructional use, for example, in the manufacture of wall, floor, ceiling or roof structures, doors and cabinets. However, such articles were conceived apparently as substitutes for plaster board or its equivalent, and as such are of considerable thickness, which means that not only are they heavy and dense, but also that the excess water that is necessary to achieve adequate wetting of the glass reinforcement requires the use of cumbersome production techniques in order to remove it. However, the removal of water by vacuum techniques tends to draw in air and create small voids and surface blemishes. Moreover the production techniques referred to above result in a poor surface finish due to denuding the surface glass of the gypsum, and among non-planar articles, could be adapted to the production only of simple two-dimensional folded shapes.

Previously proposed glass fibre reinforced plaster boards used a conventional chopped strand mat in which bundles of filaments are gathered into bundles and chopped into short lengths to form the reinforcement. In the prior art methods of producing plaster board the plaster is always mixed with water as a first stage in the production process and as the resulting paste tends to set quickly it is the usual practice to use more water that necessary to set the plaster so that a thin paste is formed and to add a setting retardent to the water.

The present invention is based on the realisation that, contrary to accepted practice and beliefs, it is possible to mix the plaster and reinforcing fibre first and then to add the necessary water to produce a reinforced plaster product of considerable strength.

According to the invention there is provided a method of making a reinforced plaster product comprising the steps of mixing plaster with a fibre reinforcement, adding an aqueous solution to the mixture, forming the mixture into the required shape and drying the resulting product.

By plaster is meant a plastic substance which solidifies in the present of water, such as gypsum, plaster of paris, cement and the like. A hemi-hydrate plaster is suitable for use in the method according to the invention.

A wetting agent is preferably added to the water and the water may be further provided with suitable additives.

By adding the water after mixing the plaster and fibre-reinforcement, it is possible to use a relatively small amount of water sufficient to mix with and cause the plaster to set. Thus the setting time can be much less that that experienced using conventional processes and this time can be reduced still further, if required, by adding a setting accelerator to the mixture. Furthermore, apparatus for use with the process according to the invention can be relatively simple and inexpensive compared with corresponding apparatus for use with conventional processes in that the need for large mixing devices for mixing the plaster and water and ovens for drying the end product is obviated.

Glass fibre may be used at the reinforcing fibre. Preferably, the fibre is distributed throughout the thickness of the lamina. In the case of glass fibre, it may be in the form of chopped strands or rovings, for example bundles of filaments, or a continuous sheet supplied from a roll for example. Preferably the glass fibre is in the form of a mat. The preferred type of mat is the very thin form known as tissue which allows a fine smooth edge to be achieved when producing a reinforced plaster lamina.

The mixture may be agitated at least before the water is added to cause the plaster to fill the voids and interstices between individual filaments of the fibre reinforcement. Agitation of the mixture is preferably continued while the water is being added thereto and for a short period after as it is found that the continued agitation assists in the mixing not only of the plaster with the fibre but also of the water with the plaster.

Additives, such as polymers, can be added to the water as required. Suitable additives are urea formaldehyde plaster reinforcing resin, a terpolymer dispersion based on vinyl acetate, vinyl versatate and vinul acrylate such as that sold under the name SYNRESYL TP123DF by the Synres Group of Companies.

A suitable plaster is a hemi-hydrate plaster and it is preferably used with a wetting agent such as a non-foaming detergent to improve the contact of the crystals with the glass fibre.

Further, according to the present invention, there is provided apparatus for producing a reinforced plaster product, comprising a moulding surface, means for providing a mixture of plaster and fibre reinforcement on said mouldins surface and means for wetting said mixture to hydrate said plaster. The resulting plaster product may be allowed to dry naturally or the apparatus may be provided with means for drying the product.

The moulding surface is preferably a conveyor belt which facilitates continuous production of the product in the form of a lamina.

Glass fibre may be used as the reinforcing fibre.

In an embodiment of the invention glass fibre in the form of a mat is used and the apparatus further comprises reinforcement supply means, such as a supply reel for supplying fibre-reinforcement mat to

the surface of the conveyor belt.

Plaster supply means, such as a hopper may be provided for supplying plaster over the fibre reinforcement. The hopper may be provided at its elongate outlet with gate means, such as a brush rotatably mounted with its axis of rotation parallel to the longitudinal axis of the outlet to control the supply of plaster. Speed of rotation of the brush can be made variable to control the quantity of plaster supplied to the moulding surface.

The means for providing said mixture may include vibrator means for causing said moulding surface to vibrate. Preferably the vibrator means is mounted under the upper surface of said conveyor belt.

The means for wetting the mixture may comprise at least one spray head mounted above said belt, downstream of said plaster supply means, and arranged to direct a spray or mist of water towards said belt.

Preferably the, or each spray head is positioned intermediate the plaster supply means and the vibrator means in the longitudinal direction of movement of the belt.

Smoothing means, such as a doctor plate, and/or a brush may be provided downstream of the means for wetting the mixture for improving the upper surface finish of the plaster product.

Belt-wetting means, such as a spray or trough, may be provided for wetting the moulding surface of the belt before the fibre reinforcement or plaster is applied thereto. This helps to maintain the fibre reinforcement in contact with the belt, even when the belt is subject to vibration. Water or a water/polymer mix may be used to wet the belt.

The invention will now be described by way of example with reference to the accompanying drawings, in which;

Figure 1 is a schematic, side view of the embodiment of apparatus according to the invention for producing fibre-reinforced plaster sheet,

Figure 2 is a plan view of the apparatus of Figure 1.

Figure 3 is an enlarged, side view of part of the machine in Figure 1 illustrating the operation of the process in more detail.

Referring to the drawings, there is shown apparatus 10 for producing fibre-reinforced plaster sheet or lamina 12. The apparatus 10 comprises a conveyor belt 13 driven for rotation in a clockwise direction (as shown by arrow A in Figure 1) by a shaft 14 which is in turn driven by a motor 15. For a conveyor belt having an overall length of about 50 feet and width of about 4 feet, the belt has a typical speed of 2 feet per second but such speed is not critical. The belt has side walls 13*a*, 13*b* having a height substantially equal to the thickness of the plaster sheet 12 to be produced, the surface 13*c* of the belt intermediate the side walls constituting a moulding surface. The belt can be of any suitable material and one having at least its external surface formed of a synthetic plastics material, such as polytetrafluoroethylene (PTFE) has been found satisfactory. The belt 13 runs over a supporting, rigid plate 19 mounted on a frame 21 by shock absorbing blocks 23.

In operation, a roll 16 of glass fibre tissue is mounted on a shaft 17, and a layer 16*a* is unrolled from the roll 16 and lead round a guide member 18 and onto the upper surface 13*c* of the belt 13. The belt 13 then draws the glass fibre tissue 16*a* under a hopper 22 for plaster 23, a relatively light brush or comb 24 of stainless steel for assisting the distribution of plaster across the width 13*c* of the belt, a stainless steel comb 25, and a doctor blade 26 for providing a smooth finish to the upper surface of the products 12. In practice two, three or more such doctor blades 26 may be provided along the belt depending upon the quality of the finish required. The plate or plates 26 are arranged within the hopper 22 are a plurality of blades 28 for sifting and distributing the plaster 12 in the hopper. A reciprocating motor 30 arranged to drive a cam shaft 30*a* with cams 30*b* is provided to reciprocate the blades 28, brush 24, comb 25 and doctor blade 26 in a direction transverse to the length of the belt.

A drying unit 34 is positioned at the downstream end of the belt 13 and is arranged to blow hot air towards the belt and across its width to reduce the drying time of the plaster product 12. The hot air blower 34 is not essential and could be dispensed with by increasing the length of the belt thereby to increase the distance between its downstream end and the doctor blade 26.

A vibrator 36 is positioned under the upper surface of the belt 13 and below the comb 25 so that its vibrations are transmitted to the belt by way of the steel bed 19, the frequency and magnitude of the vibrations induced in the belt being about 4 to 8 kHz and about ⅛ inch respectively. The comb 25 vibrates in sympathy with the vibrations caused by the vibrator 36 and improves the mixing of the plaster and the fibre reinforcement.

A series of water spray heads 38 are provided above and across the width of the belt as shown in a position intermediate the hopper 22 and the vibrator 36, the spray heads being arranged to direct a fine spray of water or water mixed with a plaster setting accelerator such as potassium sulphate. A polymer such as urea formaldehyde and/or a plaster reinforcing resin such as a terpolymer dispersion based on vinyl acetate, vinyl versatate and vinyl acrylate and marketed under the Trade Name SYNRESYL TP123DF by the Synres Group of Companies may also be added to the water.

A further series of spray heads 40 is arranged across the width of the belt 13 near its upstream end and is arranged to direct a spray of water or a water/polymer mixture at the belt before the glass fibre tissue 16*a* is laid thereon. This assists in maintaining the glass fibre mat 16*a* in contact with the belt as it proceeds along the apparatus and can act as a release agent for the finished product.

Gate means in the form of a elongate brush 35 of circular cross section 15 is fixedly mounted on a shaft 35*a* in the elongate outlet slot 22*a* of the hopper 22. The shaft 35*a* and hence the brush 35 is arranged to be rotatably driven in a direction indicated by arrow B by a motor 37 to deliver plaster 12 and prevent any tendency for the plaster to bridge the gap over the outlet 22*a* which would cause a reduction in the flow of plaster or a complete stoppage. The

speed of rotation of the brush 35 can also be varied to control the rate of flow of the plaster towards the belt 13. The flow of plaster through the outlet 22*a* can be interrupted by stopping rotation of the brush 35 to allow for maintenance or adjustment of the apparatus or at the end of a production run. In addition, the bristles of the brush are made flexible so that the brush 35 is self-cleaning.

In operation, the hopper 22 is filled with plaster 23, such as hemi-hydrate plaster and glass fibre tissue 16*a* is led under the hopper 22 where it is covered with a layer of dry plaster, the brush 35 and the brush 24 ensuring that the plaster 23 is distributed evenly over the glass fibre tissue 16*a* and to a predetermined depth. As the belt 13 amd the mat 16*a* with its plaster covering moves to the right (in Figure 1), the vibrations of the belt 13 caused by vibrator 36 are transmitted to the mat and the resulting agitation caused the plaster crystals to fill the voids between the individual filaments of the tissue. Then the tissue and plaster mixture is sprayed with water from the spray heads 38, the plaster takes-up water and as the wet sheet continues towards the downstream end of the apparatus 10, it is subject first to vibrations of increasing magnitude as it proceeds towards and passed over the vibrator 36 and then to vibrations of decreasing magnitude as it proceeds away from the vibrator. The vibrations further improve the mixing of the water and the plaster and of introducing the now wet plaster paste into the voids and interstices in the glass fibre tissue.

The wet plaster/fibre sheet then passes under doctor plate or plates 26, which assist in further distributing plaster and any surplus water over the surface of the composite sheet. The plate 26 is held loosely so that it rests on the walls 13*a*, 13*b* of the belt 13 and so is free to vibrate with the belt thus helping to compact and form the reinforced plaster sheet 12. One or more of the plates 26 are also arranged to reciprocate transversely of the belt as described, which action also serves to improve the finish of the final product. Finally, the plaster sheet is dried as it passes under the hot air blower 34 and is then passed to a receiving station shown schematically at 42 where it can be processed as required for example by being cut into sheets.

The resulting product is thus a glass fibre reinforced plaster sheet in which the glass fibre reinforcement is distributed substantially throughout the thickness of the sheet. The product can be quite thin, for example about 1/8 inch thick and it has been found that such a product has a relatively high resistance to both physical and thermal shock, is relatively easy to cut and does not require the paper cover sheets required by conventional plaster boards which add considerably to the cost of the final product.

A surface coating could be applied to one surface of the reinforced sheet by feeding the required surface coating material, such as a sheet of a textured and/or patterned plastics material or a veneer onto the conveyor belt underneath the fibre tissue so that the surface coating material is adhered to the reinforced plaster sheet.

Various modifications can be made to the apparatus and to the method of the invention, provided that the plaster and the fibre reinforcement are at least partially mixed before the water is added. For example, it is beli ved that it would be possible to make a fibre-reinforced plaster sheet by distributing a layer of plaster on the conveyor belt and then sprinkling a fibre-reinforced such as chopped strand glass fibre on the surface of the powder, mixing the two by vibration and then adding the water as hereinbefore described. Furthermore, the vibrator 36 could be mounted onto the conveyor belt 15 floating on a stainless steel mounting but this arrangement is not so convenient especially when the machine is to be stopped for cleaning.

Furthermore, if the product is taken from the conveyor belt 14 while still wet, it could be moulded into a required shape such as s dome or wrapped around a mandrel to form a duct or tube.

The product can also be used in the manufacture of a composite product having a sandwich construction in which an inner core of a material, such as chipboard, or expanded polystyrene, which may be, for example, in a solid or honeycomb form, is covered with a reinforced plaster product according to the invention. Such a sandwich construction could be made by laying a core material (not shown) on the upper surface of the product 12 after it passes the blower 34, the belt 13 being extended further to the right (in figure 1), and unrolling a sheet or a similar product from another apparatus according to the invention so that the upper surface of the product as it leaves the belt of the other apparatus is in contact with the core. The resulting sandwich construction has a good external appearance as the exteranl surface of each reinforced plaster sheet is the surface which was in contact with the belt on which it was produced. Such a composite product can be used for wall panelling, partitioning, cladding, doors and the like with good fire retardant properties.

Thus there has been described a simple and cheap method of and apparatus for making reinforced plaster products. Mixing, at least partially, the fibre reinforcement and the plaster while the plaster is in a dry state facilitates the use of a relatively simple, inexpensive and small apparatus, which apparatus is suitable for batch production of the product as and when it is required. Apparatus according to the invention for producing plaster board for example could therefore be sited adjacent or near to a large building complex, such as a hospital, new town or the like and then dismantled when building is complete. In contrast, apparatus for making plaster board by conventional methods is relatively large and expensive and requires substantial plaster mixing equipment and, because plaster sets quite rapidly, it is necessary to mix the plaster with an excessive amount of water and perhaps a plaster-setting retardant and the resulting product has to be passed through a series of ovens to remove the excess water. Thus by their very nature, conventional methods tend to be operated as continuous production processes at permanent sites. At the present time, world wide production of plaster board is carried on at only a few production plants and the shipping costs can add considerably to the price of

the board to the eventual user.

It is believed that the agitation due to the operation of the vibrator 36 causes a shearing action initially betw en the dry plaster and the individual filaments of the fibre reinforcement and later between the plaster, filaments and water to provide the extremely good mixing of the constituents which is achieved in practice.

CLAIMS

1. A method of making a reinforced plaster product comprising the steps of mixing plaster with a fibre reinforcement, adding water to the mixture and drying the resulting product.

2. A method according to Claim 1, in which the plaster is selected from gypsum, plaster of paris, cement or a hemi-hydrate plaster.

3. A method according to Claim 1 or 2, in which a wetting agent is added to the water.

4. A method according to Claim 1, 2 or 3, in which a setting accelerator is added to the mixture.

5. A method according to Claim 1, 2, 3 or 4, in which glass fibre is used as the reinforcing fibre.

6. A method according to any one of Claims 1 to 5, in which the mixing step is arranged to distribute the fibre reinforcement throughout the thickness of the product.

7. A method according to any one to the preceding claims, in which the fibre reinforcement is chopped strands or rovings, for example bundles of filaments or a continuous sheet supplied from a roll for example.

8. A method according to any one of the preceding claims, in which the fibre is in the form of a mat.

9. A method according to any one of the preceding claims in which the mixture is agitated at least before the water is added to cause the plaster to fill the voids and interstices between individual filaments of the fibre reinforcement.

10. A method according to Claim 9, in which agitation of the mixture is continued while the water is being added thereto and for a short period after.

11. A method according to any one of the preceding claims in which at least one additive is added to the water, suitable additives being waterproofing agents, fungus inhibitors and plaster reinforcing resins, such as urea formaldehyde plaster reinforcing resin, a terpolymer dispersion based on vinyl acetate, vinyl versatate and vinyl acrylate.

12. A method of making a reinforced plaster product substantially as hereinbefore described with reference to the drawings.

13. Apparatus for producing a reinforced plaster product, comprising a moulding surface, means for providing a mixture of plaster and fibre reinforcement on said moulding surface and means for wetting said mixture to hydrate said plaster.

14. Apparatus according to Claim 13, in which the apparatus is provided with means for drying the product.

15. Apparatus according to Claim 13 or 14, isurface is a conveyor belt which facilitates continuous production of the product in the form of a lamina.

16. Apparatus according to Claim 13, 14 or 15, in which the reinforcing fibre is glass fibre.

17. Apparatus according to Claim 16, in which the fibre is in the form of a mat and the apparatus further comprises reinforcement supply means, such as a supply reel, for supplying fibre-reinforcement mat to the surface of the conveyor belt.

18. Apparatus according to any one of Claims 13 to 17, further comprising plaster supply means for storing and supplying plaster to the moulding surface.

19. Apparatus according to Claim 18, wherein the plaster supply means is arranged to supply plaster over fibre reinforcement previously applied to the moulding surface.

20. Apparatus according to Claim 18 or 19, in which the plaster supply means is a hopper with an outlet aperture for the plaster, the aperture being provided with gate means for controlling the flow of plaster.

21. Apparatus according to Claim 20, in which the outlet is elongate extending in a direction across the moulding surface and the gate means comprises a brush rotatably mounted in the outlet with its axis of rotation substantially parallel to the longitudinal axix of the outlet, and means for rotating the brush.

22. Apparatus according to Claim 21, in which the means for rotating the brush comprises means for varying the speed of rotation of said brush to vary the rate of flow of the plaster.

23. Apparatus according to Claim 19, 20, 21 or 22 in which the hopper is provided with means for distributing the plaster within the hopper.

24. Apparatus according to Claim 23, in which the means for distributing the plaster in the hopper comprises a plurality of blade members extending across the hopper in a direction towards the outlet.

25. Apparatus according to Claim 24, comprising means for imparting a reciprocatory movement to at least part of said blade members such that the free ends thereof move in a direction substantially parallel to the longitudinal axis of said outlet.

26. Apparatus according to any one of Claims 13 to 25, in which the means for providing said mixture includes means for agitating said plaster and fibre reinforcement to cause the plaster to fill the voids between individual filaments of the fibre reinforcement.

27. Apparatus according to Claim 26, in which the agitating means is a vibrator arranged to vibrate at least part of said moulding surface.

28. Apparatus according to Claim 27, as dependent upon Claim 15, in which said vibrator is mounted under the upper surface of said conveyor belt.

29. Apparatus according to any one of Claims 13 to 28, in which said means for wetting said mixture comprises at least one spray means arranged to direct a spray or mist or water towards said mixture.

30. Apparatus according to Claim 29, as dependent upon Claim 27 or 28, in which the spray means is positioned intermediate said plaster supply means and said means for agitating.

31. Apparatus according to Claim 15 or any one of Claims 16 to 30 as dependent upon Claim 15,

further comprising smoothing means, such as a doctor plate, downstream of said means for wetting the mixture.

32. Apparatus according to Claim 31, including means for providing a reciprocatory movement to the or each doctor blade in a direction transverse to the direction of movement of said conveyor belt.

33. Apparatus according to Claim 15 or any one of Claims 16 to 32 as dependent upon Claim 15, further comprising comb means arranged above said moulding surface so that the free ends of the tines of the comb contact, in use, said mixture to assist distribution of the plaster.

34. Apparatus according to Claim 33 including means for providing a reciprocatory movement to said comb means in a direction transverse to the direction of movement of said conveyor belt.

35. Apparatus according to any one of Claims 15 to 34 further comprising means for applying a wetting agent and/or a product release agent to the moulding surface before said mixture is supplied thereto.

36. Apparatus for producing a reinforced plaster product substantially as hereinbefore described with reference to an as illustrated in Figures 1 and 2 of the accompanying drawings.

37. A reinforced plaster product made according to any one of the methods of Claims 1 to 13 or on apparatus according to any one of Claims 13 to 36.

38. A composite reinforced plaster product comprising a product according to claim 37 laminated to another laminar material.

39. The features as herein disclosed, or their equivalents, in any novel selection.

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon Surrey, 1978.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.